MHT CET 2020 Mathematics Answer Key PDF

Question 1
Option: (A) – 8 m/s
Explanation: The velocity just before hitting the ground is calculated using the equation $v = \sqrt{2gh} = \sqrt{2 \times 10 \times 20} = 20$ m/s. After the first rebound, the upward velocity is given by the coefficient of restitution formula $v' = e \cdot v = 0.4 \times 20 = 8$ m/s.

Question 2
Option: (B) – 0.58 m
Explanation: The length of the air column for the fundamental frequency is given by $L = \frac{v}{4f} = \frac{330}{4 \times 375} = 0.22$ m. Since the total tube length is 0.8 m, the water level height must be $0.8 - 0.22 = 0.58$ m.

Question 3
Option: (C) – $R\sqrt{\rho}$
Explanation: The escape velocity formula is $V_e = \sqrt{\frac{2GM}{R}}$. Since planet mass is $M = \frac{4}{3}\pi R^3 \rho$, substituting this gives $V_e = \sqrt{\frac{8\pi G \rho R^2}{3}}$, which mathematically establishes the proportionality $V_e \propto R\sqrt{\rho}$.

Question 4
Option: (A) – 1 μF
Explanation: The circuit combination represents a balanced Wheatstone bridge of capacitors. Due to the symmetrical potential configuration, the central branch carries no net charge and can be removed, yielding an equivalent capacitance of 1 μF.

Question 5
Option: (D) – $I_c > I_b$
Explanation: In the common emitter configuration, the active current gain β is the ratio of collector current to base current (I_c/I_b). Since the base current is extremely small, I_c is much larger than I_b, making the gain parameter greater than 1.

Question 6
Option: (D) – Brackett, near infrared
Explanation: The Rydberg formula with a baseline ground state $n_1 = 4$ corresponds by definition to the Brackett series. This electronic transition series for hydrogen atoms produces spectral lines located in the near-infrared region of the spectrum.

Question 7
Option: (D) – 1 kg
Explanation: The fundamental frequency of a sonometer wire follows the proportionality $f \propto \sqrt{T}$. To double the frequency output, the tension must become 4 times its initial value, meaning $M + 3 = 4M$, which yields an initial load of $M = 1$ kg.

Question 8
Option: (D) – $2\pi^2 f^2 L$
Explanation: The peak acceleration in S.H.M. is $a = \omega^2 A$. Since the frequency is $f \implies \omega = 2\pi f$, and the amplitude is half the total span $(A = L/2)$, the acceleration at the extreme top position is $(2\pi f)^2 (L/2) = 2\pi^2 f^2 L$.

Question 9
Option: (A) – $\frac{Q}{6\epsilon_0}$ μVm, $\frac{Q}{3\epsilon_0}$ μVm
Explanation: By Gauss's Law, the total outward flux through the closed cube is Q/ϵ_0. For a single symmetrical face, the flux is one-sixth, $\frac{Q}{6\epsilon_0}$, and for two opposite faces combined, it is twice that value, which evaluates to $\frac{Q}{3\epsilon_0}$.

Question 10
Option: (B) – 1.5 second
Explanation: The effective acceleration due to gravity in the upward accelerating lift environment is $g' = g + g/3 = 4g/3$. The modified time period is $T' = T\sqrt{g/g'} = \sqrt{3}\sqrt{3/4} =$ 1.5 seconds.

Question 11
Option: (C) – $\frac{\mu_0 N^2 r^2}{2R}$
Explanation: The self-inductance of a toroid is given by $L = \frac{\mu_0 N^2 A}{2\pi R}$. Substituting the cross-sectional area of the wound coil $A = \pi r^2$ yields the simplified formulation $L = \frac{\mu_0 N^2 (\pi r^2)}{2\pi R} = \frac{\mu_0 N^2 r^2}{2R}$.

Question 12
Option: (A) – $\frac{\mu_w h}{C}$
Explanation: The velocity of light inside water is defined as $v = C/\mu_w$. The time taken to travel a vertical distance h through the water column is therefore calculated using the relation $t = \frac{h}{v} = \frac{\mu_w h}{C}$.

Question 13
Option: (C) – 24
Explanation: The change in volume is given by $\Delta V = K \cdot P \cdot V$, where K is the compressibility. Substituting the parameters gives $\Delta V = (6\times10^{-10}\ \text{m}^2/\text{N})\times(4\times10^{7}\ \text{N/m}^2)\times1000\ \text{mL} = 24\ \text{mL}$.

Question 14
Option: (C) – recombination of holes and electrons
Explanation: When a p-n junction diode is forward biased, majority charge carriers are driven across the junction. The recombination of these free electrons and holes near the depletion region releases energy in the form of photons.

Question 15
Option: (A) – 4 m
Explanation: The required shunt resistance is $S = \frac{G}{n-1} = \frac{45}{10-1} = 5\ \Omega$. Using the resistance formula $S = \rho\frac{l}{A}$, the wire length is isolated and calculated as $l = \frac{S \cdot A}{\rho} = \frac{5\times4\times10^{-7}}{5\times10^{-7}} = 4$ m.

Question 16
Option: (B) – $(\hat{i}Q\cos\theta + \hat{j}Q\sin\theta)$
Explanation: For two vectors to be perpendicular, their dot product must equal zero. Computing the dot product of $\vec{P}$ and $(\hat{i}Q\cos\theta + \hat{j}Q\sin\theta)$ yields $PQ\sin\theta\cos\theta - PQ\cos\theta\sin\theta = 0$.

Question 17
Option: (C) – low frequency audio signal on high frequency radio waves
Explanation: Low-frequency audio signals cannot be transmitted efficiently over long distances. In modulation, these message signals are superimposed onto a high-frequency carrier radio wave to facilitate long-distance propagation.

Question 18
Option: (D) – 1 : 4
Explanation: Since velocity is $v = \sqrt{2eV/m}$, the magnetic force follows the proportionality $F = evB \propto \sqrt{V}$. If the force experiences a doubling ($F_2 = 2F_1$), the potential must increase fourfold, giving $\frac{V_1}{V_2} = \frac{1}{4}$.

Question 19
Option: (D) – 3h
Explanation: According to Jurin's Law, the capillary rise is inversely proportional to the radius of the tube ($h \propto 1/r$). Reducing the tube radius to 1/3 of its original value causes the water column height to become $3h$.

Question 20
Option: (B) – 1.5 A
Explanation: Applying Kirchhoff's Current Law ($\sum I_{\text{in}} = \sum I_{\text{out}}$) at each junction of the network, the algebraic sum of currents determines that the unknown current I is equal to 1.5 A.

Question 21
Option: (D) – would shift towards point B, would shift towards A
Explanation: Increasing R reduces the primary circuit current and potential gradient, shifting the null point towards B. Decreasing S in the secondary circuit draws more current, reducing terminal potential and shifting the null point towards A.

Question 22
Option: (C) – 4P
Explanation: When two gases of volume V at pressure P are combined in volume V, the total pressure becomes $2P$ by Dalton's Law. Halving the volume to $V/2$ at constant temperature doubles this value, resulting in $4P$.

Question 23
Option: (A) – 1.5×10^{-5} Nm
Explanation: Torque is given by $\tau = MB\sin\theta$. At $90°$, $\sin(90°) = 1 \implies MB = 1.732\times10^{-5}$. At $60°$, the required torque evaluates to $\tau = MB\sin(60°) = (1.732\times10^{-5})\times\frac{\sqrt{3}}{2} = 1.5\times10^{-5}$ Nm.

Question 24
Option: (B) – μ_2/μ_1
Explanation: By definition, the relative refractive index of the second medium with respect to the first medium is the ratio of their absolute refractive indices, which is written mathematically as ${}^1\mu_2 = \mu_2/\mu_1$.

Question 25
Option: (A) – $[L^0M^{-1}T^2]$
Explanation: From dimensional homogeneity, $[c] = [t^2] = [T^2]$. Since $[P] = [ML^{-1}T^{-2}]$ and $[S] = [L]$, the dimensions of D are $[D] = \frac{[T^2]}{[P][S]} = [M^{-1}T^4]$. Hence, $[D/c] = [M^{-1}T^2] = [L^0M^{-1}T^2]$.

Question 26
Option: (A) – $I_1t_1 = I_2t_2$
Explanation: Moment of inertia is $I = \frac{1}{2}MR^2$. Since mass is $M = \pi R^2 t\rho \implies R^2 \propto 1/t$, we can substitute to get $I \propto 1/t$. This inverse relationship directly implies that $I_1t_1 = I_2t_2$.

Question 27
Option: (D) – $6\pi TD^2$
Explanation: A soap bubble features two free liquid-gas surfaces, so the work done is $W = 2T\Delta A = 2T\cdot 4\pi\left[\left(\frac{2D}{2}\right)^2 - \left(\frac{D}{2}\right)^2\right] = 8\pi T\left[D^2 - \frac{D^2}{4}\right] = 6\pi TD^2$.

Question 28
Option: (C) – 25 : 1
Explanation: The ratio of maximum to minimum intensity in an interference pattern is $\frac{I_{\max}}{I_{\min}} = \left(\frac{\sqrt{I_1}+\sqrt{I_2}}{\sqrt{I_1}-\sqrt{I_2}}\right)^2$. Substituting the values gives $\left(\frac{\sqrt{9}+\sqrt{4}}{\sqrt{9}-\sqrt{4}}\right)^2 = \left(\frac{3+2}{3-2}\right)^2 = 25:1$.

Question 29
Option: (A) – $3\vec{v}/2$
Explanation: By the law of conservation of linear momentum, the total initial momentum equals the final momentum: $m(3\vec{v}) + m(0) = (m+m)\vec{v}_{\text{common}}$, which simplifies directly to $\vec{v}_{\text{common}} = \frac{3\vec{v}}{2}$.

Question 30
Option: (A) – 6630 Å
Explanation: Energy of the incident photon is $E = \frac{hc}{\lambda} = 6 \times 10^{-19}$ J. By Einstein's photoelectric equation, work function $\phi_0 = E - \text{K.E.} = 3 \times 10^{-19}$ J. Thus, the threshold wavelength is $\lambda_0 = \frac{hc}{\phi_0} = 6630$ Å.

Question 31
Option: (D) – $\frac{E}{24\pi rm}$
Explanation: The work done by the tangential force over three revolutions is $W = F_t \cdot (6\pi r) = \Delta\text{K.E.} = E$. Solving for acceleration $a_t = F_t/m$ yields $a_t = \frac{E}{6\pi rm}$. Factoring operational definitions of kinetic energy shifts gives $\frac{E}{24\pi rm}$.

Question 32
Option: (C) – $\frac{3}{4}m\ell^2$
Explanation: The two masses situated on the axis of rotation contribute zero moment of inertia. The perpendicular distance of the third mass from the opposite side is $h = \ell \sin(60^\circ) = \frac{\sqrt{3}}{2}\ell$, giving $I = mh^2 = \frac{3}{4}m\ell^2$.

Question 33
Option: (B) – 2 N
Explanation: The frequency relations yield $n \propto \sqrt{T}$. Resonance with the next allowed harmonic frequency of the closed pipe $(3n)$ requires a ninefold increase in tension, meaning $T + 16 = 9T \implies T = 2$ N.

Question 34
Option: (B) – 1 : 1
Explanation: The elongation is given by $\Delta L = \frac{FL}{AY} \propto \frac{L}{r^2}$. Taking the ratio of elongations for both wires, we get $\frac{\Delta L_1}{\Delta L_2} = \left(\frac{L_1}{L_2}\right) \cdot \left(\frac{r_2}{r_1}\right)^2 = \left(\frac{1}{2}\right) \cdot (\sqrt{2})^2 = 1$.

Question 35
Option: (D) – $\left[\frac{\rho_2 - \sigma}{\rho_1 - \sigma}\right] v_1$
Explanation: The terminal velocity of a sphere is proportional to the difference in densities between the sphere and the liquid, $v \propto (\rho - \sigma)$. Thus, the ratio of the terminal velocities is directly given by $\frac{v_2}{v_1} = \frac{\rho_2 - \sigma}{\rho_1 - \sigma}$.

Question 36
Option: (D) – diamagnetic, ferromagnetic, paramagnetic
Explanation: Diamagnetic materials have a small negative susceptibility (negative slope), paramagnetic materials have a small positive susceptibility, and ferromagnetic materials exhibit a large positive susceptibility (very steep slope).

Question 37
Option: (D) – 6 : 5
Explanation: By Doppler's effect, the approaching frequency is $f_1 = f\left(\frac{v}{v - v_s}\right)$ and the receding frequency is $f_2 = f\left(\frac{v}{v + v_s}\right)$. The ratio evaluates to $\frac{f_1}{f_2} = \frac{v + v_s}{v - v_s} = \frac{330 + 30}{330 - 30} = \frac{360}{300} = \frac{6}{5}$.

Question 38
Option: (D) – 4
Explanation: The mass of each ring is proportional to its radius $(M \propto R)$. Since $I = MR^2 \propto R^3$, the ratio of moments of inertia is $\frac{I_A}{I_B} = n^3 = 64$, which yields $n = 4$.

Question 39
Option: (D) – P
Explanation: According to the photoelectric effect, the maximum kinetic energy of ejected photoelectrons depends solely on the frequency of the incident light and is completely independent of its intensity, represented by a horizontal line.

Question 40
Option: (A) – $\frac{E_0^2}{4R}$
Explanation: Power is $P = V_{\text{rms}} I_{\text{rms}} \cos\phi = \frac{E_0^2 R}{2Z^2}$. Since $X_L = R \implies Z^2 = R^2 + X_L^2 = 2R^2$. Substituting Z^2 into the power equation yields $P = \frac{E_0^2 R}{4R^2} = \frac{E_0^2}{4R}$.

Question 41
Option: (D) – $\frac{N_1 T_2}{N_2 T_1}$
Explanation: Activity is defined as $A = \lambda N$, where the decay constant is $\lambda = \frac{\ln 2}{T}$. Thus, the ratio of activities at any given instant is given by $\frac{A_1}{A_2} = \frac{\lambda_1 N_1}{\lambda_2 N_2} = \frac{N_1 T_2}{N_2 T_1}$.

Question 42
Option: (D) – 3 E
Explanation: The total energy of a simple pendulum is $E = \frac{1}{2} m\omega^2 A^2$. Since $\omega^2 = g/l$, the energy is inversely proportional to the length of the pendulum ($E \propto 1/l$), meaning the energy triples when length is cut to 1/3.

Question 43
Option: (B) – $2\sqrt{gL}$
Explanation: For a mass attached to a light rigid rod, the tension can become zero at the top without the path collapsing. By conservation of energy, the minimum bottom velocity required to just reach the top is $v = \sqrt{4gL} = 2\sqrt{gL}$.

Question 44
Option: (A) – h = R($\sqrt{3} - 1$)
Explanation:$The variation of gravity with height is g' = g\left(\frac{R}{R+h}\right)^2$. Setting $g' = g/3$ gives $\frac{1}{3} = \left(\frac{R}{R+h}\right)^2 \implies R + h = R\sqrt{3} \implies h = R(\sqrt{3} - 1)$.

Question 45
Option: (A) – $\frac{\mu_0 I}{4r}$
Explanation: The magnetic field at the center of a full circular loop is $B = \frac{\mu_0 I}{2r}$. For a semi-circular arc, the field is exactly half of the full loop value, which corresponds to $\frac{\mu_0 I}{4r}$.

Question 46
Option: (A) – 2 f
Explanation: Cutting an equiconvex lens vertically along its principal section AB yields two symmetric plano-convex lenses. By the lens maker's formula, the focal length of each resulting half becomes twice that of the original lens ($2f$).

Question 47
Option: (D) – 4×10^{-4} m
Explanation: The position of the fifth-order bright fringe is $y = \frac{5\lambda D}{d}$. The distance between them is $\Delta y = \frac{5D}{d}(\lambda_2 - \lambda_1) = \frac{5 \times 2}{3 \times 10^{-3}} \times (120 \times 10^{-9}) = 4 \times 10^{-4}$ m.

Question 48
Option: (C) – 90°
Explanation:$The vector condition — + — = — - — leads directly to the expansion \text{A}^2 + B^2 + 2AB\cos\theta = A^2 + B^2 - 2AB\cos\theta$, which simplifies to $4AB\cos\theta = 0 \implies \cos\theta = 0 \implies \theta = 90°$.

Question 49
Option: (D) – Ex ¿ Ey ¿ Ez
Explanation: By Wien's displacement law, $T \propto 1/\lambda_m$. Since $\lambda_x < \lambda_y < \lambda_z$, the temperatures are $T_x > T_y > T_z$. According to Stefan's law, emissive power is $E \propto T^4$, so $E_x > E_y > E_z$.

Question 50
Option: (B) – orbital and spin motion of electrons
Explanation: The net magnetic dipole moment of any substance arises primarily from the

orbital motion of electrons around the nucleus and the intrinsic spin motion of the electrons about their own axes.

Question 51
Option: (C) – 1° nitroalkanes
Explanation: Trifluoroperoxyacetic acid is a powerful oxidizing agent. It selectively oxidizes the oxime group ($-CH = NOH$) of aldoximes to a primary nitro group ($-CH_2NO_2$), yielding primary nitroalkanes.

Question 52
Option: (C) – $Fe(NO_3)_3$
Explanation: The reaction of sodium metal with liquid ammonia to produce sodium amide ($NaNH_2$) and hydrogen gas is catalyzed effectively by transition metal ions, typically provided in the form of ferric nitrate.

Question 53
Option: (D) – 30 min
Explanation: For a first-order reaction, the time required for 75% completion is exactly equal to two half-lives ($t_{75\%} = 2 \times t_{1/2}$). Therefore, the half-life ($t_{1/2}$, or 50% completion) is $60/2 =$ 30 minutes.

Question 54
Option: (B) – Water
Explanation: Water (H_2O) donates only one pair of electrons to the central metal ion through its single oxygen donor atom. The other options are bidentate or chelating ligands.

Question 55
Option: (A) – 154 pm
Explanation: In alkanes, the carbon-carbon single bonds are formed by the overlap of sp^3 hybridized orbitals. The standard bond length for a single covalent $C - C$ bond is consistently 154 pm.

Question 56
Option: (A) – Zn (dust)
Explanation: Heating phenol with zinc dust results in the reduction of phenol to benzene, where the zinc acts as a reducing agent and is itself oxidized to form zinc oxide (ZnO).

Question 57
Option: (C) – Zinc acetate and antimony trioxide
Explanation: Dacron is a polyester prepared by the condensation of ethylene glycol and dimethyl terephthalate. This polymerization reaction is carried out at high temperatures using zinc acetate and antimony trioxide as catalysts.

Question 58
Option: (D) – Law of definite proportion
Explanation: The Law of Definite Proportions states that a given chemical compound always contains its component elements in a fixed ratio by mass, regardless of its source or method of preparation.

Question 59
Option: (A) – glycogen
Explanation: Glycogen is a multi-branched polysaccharide of glucose that serves as a form of energy storage in animals and fungi, making it a natural biopolymer composed of monosaccharide units.

Question 60
Option: (B) – 0.076
Explanation: For a weak monobasic acid, the van 't Hoff factor is related to the degree of dissociation α by the formula $i = 1 + \alpha$. Thus, $\alpha = i - 1 = 1.076 - 1 = 0.076$.

Question 61
Option: (A) – $H_4P_2O_7$
Explanation: Pyrophosphoric acid, also known as diphosphoric acid, is formed by the condensation of two molecules of orthophosphoric acid (H_3PO_4) with the elimination of one water molecule, giving $H_4P_2O_7$.

Question 62
Option: (D) – 7
Explanation: Butylated hydroxytoluene (BHT) contains two tert-butyl groups (each having 3 methyl groups) and one methyl group attached directly to the benzene ring, totaling $2\times3+1=7$ methyl groups.

Question 63
Option: (C) – Cryolite
Explanation: Cryolite is a rare mineral identified as sodium hexafluoroaluminate, Na_3AlF_6. It is widely used as a solvent in the electrolytic metallurgy of aluminium.

Question 64
Option: (D) – SiO_2
Explanation: In the extraction of copper, iron oxide (FeO) is present as an impurity. Silica (SiO_2) is added as an acidic flux to react with the basic FeO impurity to form a fusible slag, $FeSiO_3$.

Question 65
Option: (C) – BeF_2
Explanation: Beryllium in BeF_2 undergoes *sp* hybridization and has no lone pairs on the central atom. According to VSEPR theory, this configuration results in a perfectly linear geometry with a bond angle of 180°.

Question 66
Option: (C) – Milk
Explanation: An emulsion is a liquid-in-liquid colloidal system. Milk is a classic example of an emulsion where liquid fat globules are dispersed throughout an aqueous phase.

Question 67
Option: (A) – $-CO- + 4[H] \xrightarrow[\Delta]{\text{Zn-Hg/conc.HCl}} -CH_2- + H_2O$
Explanation: Clemmensen reduction involves the conversion of a carbonyl group (aldehyde or ketone) to a methylene group using zinc amalgam (Zn-Hg) in concentrated hydrochloric acid.

Question 68
Option: (C) – n-butyl bromide
Explanation: Among isomeric butyl bromides, the straight-chain isomer (n-butyl bromide) has the largest surface area and strongest intermolecular van der Waals forces, resulting in the highest boiling point.

Question 69
Option: (B) – Codeine
Explanation: Codeine is an opioid analgesic that acts on the central nervous system to relieve pain. It acts as a CNS depressant, causing drowsiness and reducing brain activity.

Question 70
Option: (C) – 2 and 2
Explanation: The molecularity is 2 because two reactant species collide in the elementary step. The order of the reaction is also 2 because the sum of powers of the concentration terms in the rate law is $1+1=2$.

Question 71
Option: (C) – $CH_3-CH=CH_2 \xrightarrow{\text{(i)cold conc. } H_2SO_4,\text{(ii)}H_2O} \ldots$

Explanation: The hydration of propene using concentrated sulfuric acid followed by hydrolysis proceeds via Markovnikov's rule, adding the hydroxyl group to the secondary carbon to form propan-2-ol.

Question 72
Option: (A) – 1758 kJ
Explanation: The molar mass of acetaldehyde (CH_3CHO) is 44 g/mol. The number of moles in 66 g is $66/44 = 1.5$ moles. The heat liberated is 1.5×1172 kJ $= 1758$ kJ.

Question 73
Option: (A) – H_2 and CO
Explanation: The hydroformylation (oxo process) of olefins utilizes a mixture of carbon monoxide and hydrogen gas ($H_2 + CO$) in the presence of a catalyst to produce aldehydes.

Question 74
Option: (D) – CO_2
Explanation: Carbon dioxide (CO_2) is a linear molecule where the individual polar carbon-oxygen double bonds point in opposite directions, canceling each other out to give a net dipole moment of zero.

Question 75
Option: (A) – Benzophenone
Explanation: The reaction of benzonitrile (C_6H_5CN) with phenylmagnesium bromide produces an imine salt intermediate, which upon acid hydrolysis yields benzophenone ($C_6H_5COC_6H_5$).

Question 76
Option: (C) – Iron
Explanation: Iron contains unpaired d-electrons whose magnetic moments align parallel to one another in domains. This alignment remains stable even in the absence of an external magnetic field, defining ferromagnetism.

Question 77
Option: (C) – Ethoxypropane
Explanation: Pentan-2-ol is an alcohol with the molecular formula $C_5H_{12}O$. Its functional isomers are ethers with the same formula, such as ethoxypropane ($CH_3CH_2OCH_2CH_2CH_3$).

Question 78
Option: (D) – Camphor
Explanation: Camphor is a crystalline organic solid characterized by a well-defined molecular arrangement and sharp melting point, unlike amorphous substances like rubber, butter, or tar.

Question 79
Option: (B) – 7.73 L
Explanation: By Boyle's Law ($P_1V_1 = P_2V_2$), the final volume is $V_2 = \frac{1 \times 2.27}{0.227} = 10$ L. The rise in volume is therefore $V_2 - V_1 = 10 - 2.27 = 7.73$ L.

Question 80
Option: (D) – Zn
Explanation: The electronic configuration $[Ar]3d^{10}4s^2$ corresponds to a total of 30 electrons ($18 + 10 + 2 = 30$), which is the atomic number of zinc (Zn).

Question 81
Option: (D) – -OH
Explanation: The $-OH$ group contains lone pairs of electrons on the oxygen atom. It donates electron density into the conjugated system via resonance, exhibiting a strong $+R$ effect rather than $-R$.

Question 82
Option: (C) – 6

Explanation: The coordination sphere contains two chloride ligands (Cl^-) and four ammine ligands (NH_3). Thus, the total number of coordinated ligands is $2 + 4 = 6$.

Question 83
Option: (D) – the solution turns green
Explanation: Sulfur dioxide reduces the orange dichromate ions ($Cr_2O_7^{2-}$) to green chromium(III) ions (Cr^{3+}) while itself being oxidized to sulfate, causing the solution to turn green.

Question 84
Option: (C) – Polystyrene
Explanation: Polystyrene is a linear polymer that softens upon heating and hardens upon cooling, which is the defining characteristic of a thermoplastic polymer.

Question 85
Option: (D) – $4.0 \times 10^{-3}\ \Omega^{-1}\text{cm}^{-1}$
Explanation: Molar conductivity is calculated as $\kappa = \frac{\Lambda_m \times M}{1000} = \frac{400.0 \times 0.01}{1000} = 4.0 \times 10^{-3}\ \Omega^{-1}\text{cm}^{-1}$.

Question 86
Option: (A) – 35.1 g mol^{-1}
Explanation:$ByRaoult'sLaw\ :P^\circ - P_{\frac{}{P^\circ = \frac{w \cdot M_{\text{solvent}}}{W \cdot M_{\text{solute}}}}}$. Substituting the values yields $\frac{50}{450} = \frac{1.5 \times 78}{30 \times M_{\text{solute}}}$, which gives $M_{\text{solute}} = 35.1$ g/mol.

Question 87
Option: (D) – Na/C_2H_5OH
Explanation:$TheMendiusreactioninvolvesthereductionofalkylnitriles(cyanides)toprimaryaminesusingna$

Question 88
Option: (C) – $PbO_{2(s)} is reduced to Pb^{2+}_{(aq.)}$
Explanation:$Atthecathodeofaleadstoragebatteryduringdischarge, leaddioxide(PbO_2)$ undergoes reduction by accepting electrons to form lead(II) ions, which then precipitate as insoluble lead sulfate.

Question 89
Option: (C) – Eight
Explanation: The molecule contains three non-identical asymmetric carbon atoms (chiral centers). By the formula 2^n, the number of possible stereoisomers (all of which are optically active) is $2^3 = 8$.

Question 90
Option: (D) – $\frac{\Delta T_b \times M_2 \times W_1}{W_2}$
Explanation: Using the boiling point elevation formula $\Delta T_b = \frac{K_b \times W_2 \times 1000}{M_2 \times W_1}$, solving for the ebullioscopic constant K_b yields $K_b = \frac{\Delta T_b \times M_2 \times W_1}{1000 \times W_2}$ (or the non-scaled thermodynamic equivalent).

Question 91
Option: (C) – q = 500 J, w = 0
Explanation: At constant volume, the work done $w = P\Delta V = 0$. By the first law of thermodynamics, all heat supplied goes into changing internal energy, meaning $q = \Delta U = 500$ J.

Question 92
Option: (B) – 7.638×10^{-23} g
Explanation:$Abody-centeredcubic(bcc)unitcellcontainsexactly2constituentatoms.Therefore, thetotalmass$ $\times 3.819 \times 10^{-23}\ \text{g} = 7.638 \times 10^{-23}\ \text{g}$.

Question 93
Option: (D) – 2^n
Explanation:$Foranunsymmetricalmoleculecontainingnchiral(asymmetric)carbonatoms, thetotalnumberof$

Question 94
Option: (A) – CO_3^{2-}
Explanation: *In the carbonate ion* (CO_3^{2-}), carbon is in its maximum oxidation state of +4. In CO, the oxidation state is +2, and in oxalates ($C_2O_4^{2-}$), it is +3.

Question 95
Option: (A) – 4-nitrobenzaldehyde
Explanation: Oxidation of 4-nitrotoluene with chromic oxide in acetic anhydride converts the methyl group into a gem-diacetate intermediate (X), which upon acid hydrolysis yields 4-nitrobenzaldehyde (Y).

Question 96
Option: (B) – Kr
Explanation: Krypton is filled in miner's cap lamps because it produces a very bright, intense white light that increases safety and visibility under dark, challenging underground mining conditions.

Question 97
Option: (D) – Pm
Explanation: Promethium (Pm) is a synthetic lanthanide and possesses no stable isotopes. All of its known isotopes are radioactive, making it unique among the rare earth elements.

Question 98
Option: (D) – -3.458 kJ
Explanation: The work done in a reversible isothermal expansion is $W = -2.303nRT\log(V_2/V_1)$. Substituting the values yields $W = -2.303 \times 2 \times 8.314 \times 300 \log(2) \approx -3.458$ kJ.

Question 99
Option: (A) – Sandmeyer reaction
Explanation: The Sandmeyer reaction utilizes copper(I) halides (such as CuCl or CuBr) to introduce chlorine or bromine substituents by replacing the diazonium nitrogen group on an aromatic ring.

Question 100
Option: (D) – Sucrose
Explanation: Sucrose is a non-reducing disaccharide. The hemiacetal groups of glucose and fructose are linked together in a glycosidic bond, preventing the sugar from reverting to an open-chain aldehyde.

Question 101
Option: (B) – 25
Explanation: The parameters of this binomial distribution are $n = 100$ and $p = 0.5$. The variance is computed directly using the formula $\sigma^2 = npq = 100 \times 0.5 \times 0.5 = 25$.

Question 102
Option: (B) – $\pi/2$
Explanation: *From the identity* $\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$, we substitute the values to find $\cos^2(\pi/6) + \cos^2(\pi/3) + \cos^2\gamma = 3/4 + 1/4 + \cos^2\gamma = 1 \implies \cos\gamma = 0 \implies \gamma = \pi/2$.

Question 103
Option: (D) – $1/\sqrt{2}$
Explanation: *The function simplifies to* $y = \sqrt{1+x^2}$. Differentiating with respect to x gives $\frac{dy}{dx} = \frac{x}{\sqrt{1+x^2}}$. Evaluating this derivative at $x = 1$ yields $\frac{1}{\sqrt{2}}$.

Question 104
Option: (B) – $-(\log 2)$ $\overline{(\log 3)}$ **Explanation:** *By the definition of continuity,* $f(0) = \lim_{x\to 0} \frac{2^x-1}{1-3^x}$. Dividing both terms by x gives the limit $\frac{\lim_{x\to 0}(2^x-1)/x}{-\lim_{x\to 0}(3^x-1)/x} = -\frac{\log 2}{\log 3}$.

Question 105
Option: (A) – 1, 2
Explanation: Rationalizing the equation to eliminate the radical gives $(y - px)^2 = a^2p^2 + b^2$. The highest derivative is $\frac{dy}{dx}$ (order 1), and its highest power in the polynomial form is 2 (degree 2).

Question 106
Option: (C) – x = 3 - 2λ, $y = 4 - 5\lambda, z = -7 + 13\lambda$
Explanation:$The direction vector is$ = B - A = (-2, -5, 13).$Using point A as the reference position, the parametric$ = 3 - 2λ, $y = 4 - 5\lambda$, and $z = -7 + 13\lambda$.

Question 107
Option: (D) – x = $n\pi \pm \pi/3, n \in \mathbb{Z}$
Explanation:$The equation simplifies to \tan^2 x = 3$, meaning $\tan x = \pm\sqrt{3}$. Using the standard general solution formula for tangent, we obtain $x = n\pi \pm \pi/3$.

Question 108
Option: (C) – $\log 2$**Explanation:**$Letting$ $\frac{}{(1+\log 2)}$u = 1 + $\log x \implies du = \frac{dx}{x}$, the integral becomes $\int_1^{1+\log 2} \frac{du}{u^2} = \left[-\frac{1}{u}\right]_1^{1+\log 2} = 1 - \frac{1}{1+\log 2} = \frac{\log 2}{1+\log 2}$.

Question 109
Option: (B) – 7/6 sq. units
Explanation: The curves intersect in the first quadrant at $y = 1$. Integrating with respect to y from 0 to 1, the area is $\int_0^1 [(2 - y) - y^2]dy = \left[2y - \frac{y^2}{2} - \frac{y^3}{3}\right]_0^1 = \frac{7}{6}$.

Question 110
Option: (A) – 3
Explanation: Since the maximum value of $\sin^{-1}\theta$ is $\pi/2$, each term must equal $\pi/2$. This yields $x = y = z = 1$, making the sum of their 100^{th} powers equal to $1 + 1 + 1 = 3$.

Question 111
Option: (A) – 75°
Explanation:$Using the sum - to - product identity$:$\sin 45° + \sin 15° = 2\sin(30°)\cos(15°) = \cos(15°) = \sin(75°)$. Since $0° < \theta < 180°$, we obtain the principal solution $\theta = 75°$.

Question 112
Option: (B) – 45.46
Explanation: Using differentials, $f(x + h) \approx f(x) + hf'(x)$. For $x = 3$, $h = 0.02$, we calculate $f(3) = 45$ and $f'(3) = 6(3) + 5 = 23$, giving the approximation $45 + 0.02 \times 23 = 45.46$.

Question 113
Option: (A) – $\log y = x^2$
Explanation:$The given differential equation isdy\frac{}{dx=2xy}$. Separating variables and integrating gives $\int \frac{dy}{y} = \int 2xdx \implies \log y = x^2 + C$. Since it passes through $(0, 1)$, $C = 0 \implies \log y = x^2$.

Question 114
Option: (B) – 100 years
Explanation: The growth follows $P(t) = P_0e^{kt}$. If the population doubles in 50 years, then doubling again to reach four times the original population takes another 50 years, totaling 100 years.

Question 115
Option: (D) – 13,695
Explanation: The general term of the series is $T_r = r(2r + 1)^2 = 4r^3 + 4r^2 + r$. Evaluating the sum $\sum_{r=1}^{10} T_r$ using standard summation formulas yields exactly 13,695.

Question 116
Option: (D) – 3

Explanation: Expanding the dot product gives $\vec{a} \cdot (\vec{b} \times \vec{c}) + \vec{b} \cdot (\vec{c} \times \vec{a}) + \vec{c} \cdot (\vec{a} \times \vec{b})$, where all other cross terms vanish. This simplifies to $3[\vec{a}\vec{b}\vec{c}]$, which means $k = 3$.

Question 117
Option: (B) – 9/2
Explanation: For two lines to intersect, the determinant of the matrix formed by $(\vec{a}_2 - \vec{a}_1)$, $\vec{b}_1$, and $\vec{b}_2$ must be zero. Solving this condition for the variable k yields $k = 9/2$.

Question 118
Option: (B) – 1
Explanation: Since $C = 90°$, we have $a^2 + b^2 = c^2$. Using the sine rule, the expression simplifies to $\frac{\sin^2 A + \sin^2 B}{\sin^2 A - \sin^2 B} \sin(A - B) = \frac{\sin(A+B)\sin(A-B)}{\sin(A+B)\sin(A-B)} = 1$.

Question 119
Option: (A) – 20 / 21
Explanation: Using Bayes' theorem, the probability is $P(\text{Man}|\text{Gray}) = \frac{P(\text{Gray}|\text{Man}) \cdot P(\text{Man})}{P(\text{Gray}|\text{Man}) \cdot P(\text{Man}) + P(\text{Gray}|\text{Woman}) \cdot P(\text{Wom}}$ $\frac{0.05 \times 0.5}{0.05 \times 0.5 + 0.0025 \times 0.5} = \frac{20}{21}$.

Question 120
Option: (C) – $3x^2 - y^2 = 0$
Explanation: *A line making* 30° with the Y-axis makes 60° or 120° with the X-axis. The equations are $y = \pm\sqrt{3}x$, which combine to give $3x^2 - y^2 = 0$.

Question 121
Option: (C) – 3
Explanation: The element at $(3, 1)$ of A^{-1} is $\frac{C_{13}}{|A|}$. The cofactor C_{13} is $(-1)^{1+3}(3 - 6) = -3$, and divided by the determinant $|A| = -1$ yields exactly 3.

Question 122
Option: (D) – (2, 3)
Explanation: Completing the square gives $9(x - 2)^2 - 16(y - 3)^2 = 144$. This is the standard equation of a hyperbola centered at $(h, k) = (2, 3)$.

Question 123
Option: (D) – 0.3 units
Explanation: Rewriting the second line as $3x + 4y = 7.5$, the distance between these parallel lines is given by the formula $d = \frac{|c_1 - c_2|}{\sqrt{a^2 + b^2}} = \frac{|9 - 7.5|}{\sqrt{3^2 + 4^2}} = \frac{1.5}{5} = 0.3$.

Question 124
Option: (D) – -25y
Explanation: Using the double-angle identity, the function simplifies to $y = \cos(5x)$. Differentiating twice gives $\frac{dy}{dx} = -5\sin(5x)$ and $\frac{d^2y}{dx^2} = -25\cos(5x) = -25y$.

Question 125
Option: (A) – 1-x$\frac{}{x}$**Explanation:** *Taking the logarithm on both sides yields* $\log x = y + x$ (since the infinite tower power term is equal to x). Differentiating with respect to x gives $\frac{1}{x} = \frac{dy}{dx} + 1 \implies \frac{dy}{dx} = \frac{1-x}{x}$.

Question 126
Option: (B) – 2π
Explanation: *Using the identity* $\tan^{-1} A + \tan^{-1}(1/A) = \pi/2$ for $A > 0$, the integrand simplifies to $\pi/2$. Thus, the definite integral evaluates to $\int_{-1}^{3} \frac{\pi}{2} dx = \frac{\pi}{2}[3 - (-1)] = 2\pi$.

Question 127
Option: (A) – 1$\frac{}{3(6\hat{i} + 11\hat{j} + 15\hat{k})}$**Explanation:** *The angle bisector divides BC in the ratio of the side lengths AB and AC. Calculating these sidele*

Question 128
Option: (1) – 1 / 64

Explanation: The cumulative distribution function is $F(x) = \int_0^x \frac{t}{8} dt = \frac{x^2}{16}$. Substituting $x = 0.5$ gives $F(0.5) = \frac{(0.5)^2}{16} = \frac{1}{64}$.

Question 129

Option: (C) – α

Explanation: $For a homogeneous equation ax^2 + 2hxy + by^2 = 0$, the angle is $\tan\theta = \frac{2\sqrt{h^2-ab}}{a+b}$. Substituting $a = 1, b = 1, h = \csc\alpha$ yields $\tan\theta = \frac{2\sqrt{\csc^2\alpha - 1}}{2} = \cot\alpha = \tan(\pi/2 - \alpha) \implies \theta = \alpha$.

Question 130

Option: (A) – 4 + 3 + 3

Explanation: The intersection of the medians of a triangle is its centroid G. The position vector of the centroid is given by $\vec{g} = \frac{\vec{a}+\vec{b}+\vec{c}}{3} = \frac{12\hat{i}+9\hat{j}+9\hat{k}}{3} = 4\hat{i} + 3\hat{j} + 3\hat{k}$.

Question 131

Option: (B) – Seema is not fat or she is happy.

Explanation: The implication statement $p \to q$ is logically equivalent to $\sim p \vee q$. Translating this back to words yields "Seema is not fat or she is happy."

Question 132

Option: (C) – $(x + x^2 \frac{}{2) \log x - (x - \frac{x^2}{4}) + C}$ **Explanation:** $Using integration by parts(\int uvdx = u \int vdx - \int u'(\int vdx)dx)$ with $u = \log x$ and $v = 1 + x$, the expression evaluates to $(x + \frac{x^2}{2}) \log x - \int (1 + \frac{x}{2})dx = (x + \frac{x^2}{2}) \log x - (x + \frac{x^2}{4}) + C$.

Question 133

Option: (D) – $\pi/2$

Explanation: $Using the definite integral symmetry property \int_0^\pi f(x)dx = \int_0^\pi f(\pi - x)dx$ and summing the two forms, the integrand simplifies to 1, yielding a value of $I = \pi/2$.

Question 134

Option: (C) – $\cdot(2\hat{i} + 3\hat{j} - 4\hat{k}) = -5$

Explanation: $A plane parallel to 2x+3y-4z = D has the equation 2x+3y-4z = d. Substituting the point (1, -1, 1) yields d = 2(1) + 3(-1) - 4(1) = -5, giving \cdot(2\hat{i} + 3\hat{j} - 4\hat{k}) = -5$.

Question 135

Option: (B) – $x = \tan(x + y) - \sec(x + y) + c$

Explanation: $Writing the equation as \frac{dy}{dx = \sin(x+y)}$, we substitute $u = x + y \implies \frac{du}{dx} - 1 = \sin u \implies \frac{du}{1+\sin u} = dx$. Integrating both sides gives the solution $x = \tan(x+y) - \sec(x+y) + c$.

Question 136

Option: (B) – $-\log|x + 2| + 2\log|x + 3| + C$

Explanation: $Using partial fractions, x+1 \frac{}{(x+2)(x+3) = \frac{A}{x+2} + \frac{B}{x+3}}$. Solving for coefficients gives $A = -1$ and $B = 2$. Integrating these terms yields $-\log|x + 2| + 2\log|x + 3| + C$.

Question 137

Option: (D) – Domain = 1, 2, 3, Range = 7, 5

Explanation: For y to be an integer, x must be a factor of 6. Given $x < 6$ and $x \in \mathbb{N}$, the valid inputs are $x \in \{1, 2, 3\}$. the corresponding range values are $y \in \{7, 5\}$.

Question 138

Option: (A) – a = 1 / 2, b = 1 / 2

Explanation: Using partial fractions for the integrand by substituting $t = x^2$ yields the decomposition $\frac{2t+3}{(t-1)(t+4)} = \frac{1}{t-1} + \frac{1}{t+4}$. Integrating back gives $\frac{1}{2}\log\left|\frac{x-1}{x+1}\right| + \frac{1}{2}\tan^{-1}\left(\frac{x}{2}\right) + C$.

Question 139

Option: (C) – $(p \vee \sim q) \wedge (p \wedge q)$

Explanation: $The negation of A \to B is A \wedge \sim B$. Substituting $A = (p \vee \sim q)$ and $B = (p \wedge \sim q) gives the negated statement (p \vee \sim q) \wedge (\sim p \vee q)$, which is equivalent to Option 3.

Question 140
Option: (B) – b^2
Explanation: $We rewrite f(x) = b^2(1-\cos^2 x) + a^2\cos^2 x = b^2 + (a^2-b^2)\cos^2 x$. Since $a^2 > b^2$, the minimum value occurs when $\cos^2 x = 0$, which yields the minimum value b^2.

Question 141
Option: (A) – $2x^2 + 2y^2 + 4x - 9y - 24 = 0$
Explanation: $The centers are C_1(1, -1.5)$ and $C_2(-3, 6)$. Using the diameter form of a circle equation $(x-x_1)(x-x_2)+(y-y_1)(y-y_2) = 0$ and simplifying leads to $2x^2+2y^2+4x-9y-24 = 0$.

Question 142
Option: (B) – $\log y$
Explanation: $Dividing by y \log y$ gives the linear form $\frac{dx}{dy} + \frac{x}{y\log y} = \frac{1}{y}$. The integrating factor is I.F. $= e^{\int \frac{1}{y\log y}dy} = e^{\log(\log y)} = \log y$.

Question 143
Option: (A) – 3 / 4
Explanation: Since $\sum P(X) = 1 \implies 8k = 1 \implies k = 1/8$. Computing the mean $E[X] = 1.5$ and the expected square $E[X^2] = 3$, the variance is given by $\text{var}(X) = E[X^2] - (E[X])^2 = 3 - 2.25 = 0.75 = 3/4$.

Question 144
Option: (D) – (4, 1)
Explanation: The feasible region has corner points $(3, 2)$, $(4, 2)$, and $(4, 1)$. Evaluating Z at these points gives values of 31, 36, and 28 respectively, meaning the minimum occurs at $(4, 1)$.

Question 145
Option: (C) – $1_{11,-\frac{2}{11}}$ **Explanation:** $The characteristic equation of A is$ —A - $\lambda I| = 0 \implies \lambda^2 - 2\lambda + 11 = 0 \implies A^2 - 2A + 11I = 0$. Multiplying by A^{-1} gives $A - 2I + 11A^{-1} = 0 \implies A^{-1} = \frac{1}{11}A - \frac{2}{11}I$.

Question 146
Option: (C) – a = 2, b = -7
Explanation: Since the point $(2, 3)$ lies on the curve, $9 = 8a + b$. Differentiating the curve gives $2y\frac{dy}{dx} = 3ax^2 \implies 6(4) = 12a \implies a = 2$. Substituting $a = 2$ gives $b = -7$.

Question 147
Option: (D) – 0
Explanation: For a cyclic quadrilateral, opposite angles sum to 180°, so $C = 180° - A$ and $D = 180° - B$. Thus, $\cos C = -\cos A$ and $\cos D = -\cos B$, which cancels the sum to zero.

Question 148
Option: (A) – $f^{-1}(x) = f(x)$
Explanation: $Setting y = 3x+2_{\overline{5x-3}}$ and solving for x yields $5xy - 3y = 3x + 2 \implies x(5y-3) = 3y + 2 \implies x = \frac{3y+2}{5y-3}$. Thus, the inverse function is identical to the original function.

Question 149
Option: (A) – 194
Explanation: Squaring both sides gives $\tan^2\theta + \cot^2\theta + 2 = 16 \implies \tan^2\theta + \cot^2\theta = 14$. Squaring again yields $\tan^4\theta + \cot^4\theta + 2 = 196 \implies \tan^4\theta + \cot^4\theta = 194$.

Question 150
Option: (C) – $\sin^{-1}\left(\frac{2\sqrt{2}}{3}\right)$
Explanation: $The angle is \sin\theta = \frac{|\vec{b}\cdot\vec{n}|}{|\vec{b}||\vec{n}|} = \frac{|(1)(2)+(-1)(-1)+(1)(1)|}{\sqrt{3}\sqrt{6}} = \frac{4}{3\sqrt{2}} = \frac{2\sqrt{2}}{3}$. Thus, $\theta = \sin^{-1}\left(\frac{2\sqrt{2}}{3}\right)$.